In Country Training Programme under "Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia"

Jointly organized by Ministry of Home Affairs, Housing and Environment, Maldives, SEI, SACEP and UNEP RRC.AP, with the financial support from Sida

Report on the Maldives

Introduction

As a signatory to the Malé Decleration, the Maldives has agreed to participate in the monitoring of long range transport of air pollution and its likely impacts. Accordingly, the Maldives was recommended one monitoring station by the United Nations Environment Programme (UNEP) for this programme. The Ministry of Home Affairs, Housing and Environment (MHAHD) Government of Maldives is the National Implementing Agency (NIA). The sample monitoring and analysis will be done by the Department of Meteorology.

Monitoring Site

Site location: The monitoring station is located on the Hanimaadhoo Island, located about 400 km north of the country's capital, Malé. The same location was to be used to monitor the Atmospheric Brown Cloud.

The training programme for handling the monitoring instruments was conducted on Hanimaadhoo Island. A map of the monitoring site and its surroundings is provided in Fig 1.

The site where the instruments were to be located is at the northern tip of Hanimaadhoo Island, which is about 5 km in length and half a kilometer at its widest point. The island has an airstrip and a daily air service from Malé. It has also has a small village of a population of 800 persons located between the airstrip and the proposed monitoring station. The proposed station is about 1.5 km north of the village. The cooking energy used by the villagers is LPG. No biomass burning was reported to occur on the island. There is thick vegetation all over the island, including between the village and the proposed monitoring station.

There is a diesel generator power station of 400 KW capacity located in the village. The stack height of the station is 20 m and below the tree-line.

Monitoring for wet and dry deposition, soil and vegetation can be done on Hanimaadhoo Island. Sampling for water and aquatic ecology would have to be done on a clseby uninhabited island which has a water body.

A meteorological station exists at the airport. The station monitors wind direction and speed, relative humidity, temperature and pressure.

Though other uninhabited islands that had no anthropogenic interferences were available, transport costs to such islands would have been prohibitively expensive. It was therefore felt that Hanimadhoo island was a practical choice.

Site type: The site may be classified as a remote site.

The site met the following sitting criteria:
1. The deposition monitoring and ecological monitoring sites for soil and vegetation were identified.

2. The site is downwind of the Indian subcontinent.
3. The terrain surrounding the site is flat. About 500 km sea stretch separates the island from the Indian subcontinent.
4. There is a good vegetation that can be used for soil and vegetation surveys.
5. The deposition and ecologial monitoring sites are secure and easily accessible.
6. Sample analysis for the dry deposition samples (HVS) will be done on Hanimaadhoo Island.

The site did not meet the following criteria:

1. There may be some interference from anthropogenic activity. However, this needs to be ascertained by modeling and monitoring.
2. There will be sea salt in the air that is sampled. However, this cannot be avoided at any site in the Maldives.

Site characteristics: There may be some obstruction to free flow of wind by vegetation around the monitoring site.

Monitoring and laboratory equipment

Equipment: The monitoring and laboratory equipment and glassware given in Annex 1 was handed over to the MHAHD during the training programme held in July 2003.

Installation: Passive Sampler were installed together with the training programme. From reports provided by the MHAHD, installation of the HVS will be done in March 2004. The delay was because the construction of the building to house the equipment was possible only after the monsoon.

Training programme

An "In Country Training Programme under "Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia" was held in the meteorological station on Hanimaadhoo Island between 28 July–1 Aug 2003. The programme was organized by the Ministry of Home Affairs, Housing and Environment in collaboration with UNEP RRC.AP, SACEP and SEI.

The training programme's objective was to build national capacity to provide hands on experience on sampling and analysis of transboundary pollutants.

The technical sessions in the training programme were handled by Mr M. Iyngararasan, Mr Sagar Dhara, Mr Howard Cambridge, Mr S K Gupta, Dr R.H. Siddiqi and Dr Martin Ferm. The training programme content is provided in Annex 2

Participants: The trainees were from Ministry of Home Affairs, Housing and Environment and Department of Meteorology. The resource persons were from IVL, and Envirotech and from the collaborating centres UNEP RRC.AP and SEI. A list of participants is enclosed in Annex 3.

The trainees were young and had either bachelor-level degrees or were high school certificates. Most of them were meterologists. The team exhibited the capacity to learn the practical aspects of the work quickly.

Equipment: Training was provided to handle the following equipment:

Envirotech International: High Volume Sampler– Envirotech APM 460NL—for TSPM, PM_{10}, gaseous sampling.
IVL: Passive Samplers for SO_2 and NO_2
MISU: Wet only collector, Bulk collector

While doing the training, it was suspected that the spectrophotometer might be slightly faulty. The vendor offered to replace the instrument immediately after the suspected instrument was returned. No damage was noticed to any other equipment or glassware when they were opened in Hanimaadhoo.

Evaluation: A test paper (annex 4) was circulated amongst the trainees to assess how successful the training programme was in imparting knowledge and skills to the trainees. The answers were not marked but the answers were discussed collectively.

A participant evaluation of the programme was also done. The response questionnaire and the tabulated results of the responses are provided in Annexes 5.

Training programme experience: As a major portion of the training was handson, the trainees were enthusiastic. Several dust gaseous samples were collected and analyzed by the trainees during the training programme. Knowing the results of their monitoring boosted the confidence of the trainees.

Recommendations

1. A suitable site has to be identified for water and aquatic ecology monitoring.
2. Possible interference from emissions from anthropogenic sources should be ascertained by modeling and monitoring. This exercise can be done at minimal cost.
3. Vegetation around the monitoring site should be cleared so that they do obstruct the free flow of air to the monitoring site.
4. A follow-up visit may be done by a technician-level person in the first year after equipment installation only if requested.
5. A follow-up visit by a UNEP representative (MoC-level or equivalent) may be done in the first year after monitoring has begun to sort out problems related to data management and reporting, QA/QC, further capacity building, site change, etc.
6. Theoretical aspects of the subject, e.g., basic chemistry and statistics, QA/QC need to re-covered in future refresher courses.

Annex 1

List of Equipments and Consumables

1 Site Equipment

No.	Description	No. of Unit	Remark
1.1	PM10 air sampler	1	Envirotech model APM 460(NL)
1.2	pH meter	1	Hand held WTW model pH 300i (pH meter)
1.3	EC meter	1	Electrical conductivity meter, hand held WTW model COND 330i
1.4	Thermometer	1	Best Indian Make (-20 to 15degree C, least count 0.1 degree)
1.5	Diffusive samplers	2	For measurements at 1 site on a monthly basis during one year
1.6	Bulk sampler	2	
1.7	Wet only Collector	1	Included solar panels, solar shunt regulator

2 Laboratory - Equipment

2.1	Spectrophotometer	1	U/V and Visible Best Indian Make, Elico SL 171
2.2	Oven	1	Best Indian Make (50 to 250 degree range, 220-240V, 0.5KW)
2.3	Balance	1	Electronic Balance, Sartorius Make. Model BL210S Capacity 210g. Readability 0.1 mg
2.4	pH meter	1	Hand held WTW model pH 300i (pH meter)
2.5	Electrical conductivity meter	1	Electrical conductivity meter, hand held WTW model COND 330i
2.6	Desiccator	1	Mark 'Duran' Size 300mm
2.7	Distallation Unit	1	
2.8	Magnetic stirrer 1 L	1	Though listed as being reqd for soil qlty analysis, would be preparing for preparing solutions for DD/WD sample analysis
2.9	pH electrode for low ion concentration	1	
2.10	Calibrators		
	a) Soap Bubble Meter (manual type) (Calibrator for Rotameter)	1	
	b) Top loading Flow Calibrator	1	

3 Laboratory Consumables

A	***Glassware and other consumables***		
3.1	Washing bottle with ground glass stopper 500 ml	2	
3.2	Measuring cylinder 100 ml, 50ml, 25 ml. 10 ml	8	100 ml x 2 nos, 50ml x 2 nos, 25ml x 2 nos, 10ml x 2 nos
3.3	Glass tubes with ground-in stopper (Nessler's tubes)	12	
3.4	Volumetric flask 1000ml, 500 ml, 250 ml, 100 ml	7	1000ml x 2nos, 500 ml x 1 nos, 250 ml x 2 nos, 100 ml x 2 nos
3.5	Pipette 10 ml, 25 ml	4	10 ml x 2 nos, 25 ml x 2 nos

3.6	Filter paper Whatman 41, dia 47 mm	3	1 box = 100 nos
3.7	Bottle polypropylene 1 L, 500 ml	14	1 L x 6 nos, 500 ml x 8 nos
3.8	Beaker 100 ml, 250 ml	16	250 ml x 2 nos, 100ml x 12 nos
3.9	Regaent bottles 100ml	6	100ml x 6nos
3.10	Regaent bottles 250ml	6	250ml x 6 nos,
	Chemicals and other consumables		
3.11	2 monitoring kits		

4 Site Consumables

4.1	Filter paper Whatmans GF/A	2	Size 8"x10", in sealed pkt. Of 100 sheet
4.2	Impingers	4	35ml capacity, 4 will be supplied with hvs, 4 more are reqd as spare
4.3	Syringe 100 ml	2	5.00 each packet, in pkt. Of 10
4.4	Glass/inert plastic tubing	3	per meter, Silicon tube
4.5	Silicon grease	2	for 100 gm packet
4.6	Measuring cylinder 100 ml	2	each
4.7	Pipette 20 ml	3	10 ml x 2 nos, 20 ml x 1 nos
4.8	Polyethylene containers 20 ml	100	each - 60ml
4.90	Funnel	6	50 mm x 3 nos, 75 mm x 3 nos
4.10	Capped bottles 1 L	3	each (Tarson)
4.11	Ice box	2	each (medium size)
4.12	Power Cord 5 meter long	2	
4.13	Junction Box (Extension Board)	1	1 set
4.14	Burette (50 ml)	1	
4.15	Burette Stand	1	
4.16	Cleaning Brush for Glassware	2	
4.17	Printed paper envelopes to keep filters	1pkt	1 pkt. of 12 Nos.
4.18	Graph Pad	1 Pad.	
4.19	Iodine flask (250ml)	2	
4.20	Membrane Filtration Assembly	2	
4.21	Petridish	1	
4.22	Pipette (1 ml)	1	
4.23	Pipette (2 ml)	1	
4.24	Pipette stand	1	
4.25	Plier	1	
4.26	Pipetting Pump	1	
4.27	Silica gel (500 gm)	1	
4.28	Torch	1	
4.29	Tissue Roll	1	
4.30	Tweezer	1	
4.31	Sampling Bag	1	

Annex II

Training Programme

Day	Contents	Class/lab	Instructor
July 28	Introduction to the Malé Declaration and scope of present		
Starting at 14	program (30min)	C	MI
	Impacts of air pollution (30 min)	C	HC
Tea break	Malé monitoring network (30)	C	SD
16-16:30	Basics concepts of meteorology (30)	C	RHS/SKG
	Units and materials and energy balance (30)	C	RHS
	Setting up the lab		
July 29	Basic chemistry (30 m)	C	RHS
Starting at 9	HVS: features and setting it up (45 min)	C/L	SKG/LU
	Setting up the HVS for monitoring PM (60 min)	L	SKG/LU
Lunch 12-13	Passive sampling: theory and practice (45 min)		MF
Afternoon	pH meter (30)	C	RHS
Tea break	EC meter (30)	C	SKG/LU
16-16:30	Practical on EC meter and PH meter (60 min)	L	SKG/LU
end at 18	Wet only & bulk collector: theory (30 min)	C	MF
	Setting up wet only collector	L	MF/SD
	Setting up bulk collector	L	MF/SD
	Setting up passive samplers	L	MF
July 30	Spectrophotometer analysis (30)	C	RHS
Starting at 9	Analyzing previous day's sample & computation	C	SKG/LU
	HVS Calibration	L	SKG/LU
Afternoon	QA/QC (45 min)	L	RHS/SD
Tea break	Basic Statistics (30)	L	RHS
16-16:30	Preventive maintenance for HVS	L	SKG/LU
end at 18	Practical on Spectrophotometer	L	SKG/LU
	Setting up HVS for monitoring PM, SO_2, NO_2		
July 31	Analyzing previous day's samples for HVs, WC, BC &	C	SKG/LU
Starting at 9	computing results.	C	
		L	
Afternoon	Troubleshooting of WC, BC	C	SD/MF
Tea break	Monitoring protocol (20 min)	C	SD
16-17	Data reporting (20 min)	C	MI
	15-16:Evaluation and examination	C	MI/HC/SKG/MF
	17: Discussion, conclusion and issue of certificates	C	MI/PK
August 1	Setting up all instruments for monitoring		
Morning	Q&A, one to one discussions		

Note 1: HVS will be installed outside the lab on the 2nd day evening; Wet only collector and bulk collector will be installed outside the lab on the 2nd day; Samples will be collected and analyzed regularly until the 4th day.

Note 2:

HC:	Howard Cambridge, SEI	LU:	Lokendra Upadhyay, Envirotech
MF:	Martin Firm, IVL	MI:	Mylvakanam Iyngararasan, UNEP/RRC.AP
PK:	P K Kotta, SACEP	RHS:	Rashid H Siddiqi, Envirotech
SD:	Sagar Dhara, MoC	SKG:	S K Gupta, Envirotech

Annex III

Trainees Participants List

1.	Ahmed Shameem	Technician Grade 1 Department of Meteorology
2.	Adam Mohamed	Meteorological Observer Trainee Department of Meteorology
3.	Raheema Gasim	Meteorological Observer Trainee Department of Meteorology
4.	Ahmed Sameer	Senior Meteorological Observer Department of Meteorology
5.	Ahmed Jameel	Environmental Engineer Ministry of Home Affairs, Housing and Environment
6.	Lubna Moosa	Assistant Environment Analyst Ministry of Home Affairs, Housing and Environment
7.	Aminath Nazra	Assistant Environment Officer Ministry of Home Affairs, Housing and Environment
8.	Ibrahim Hassan	Environment Officer Trainee Regional Development Project Office (North)

Resource Participants list

1)	Howard Cambridge,	SEI
2)	Lokendra Upadhyay,	Envirotech
3)	Martin Firm,	IVL
4)	Mylvakanam Iyngararasan,	UNEP/RRC.AP
5)	P K Kotta,	SACEP
6)	Rashid H Siddiqi,	Envirotech
7)	Sagar Dhara,	MoC
8)	S K Gupta,	Envirotech

Annex IV

(**TEST PAPER**)

1. Which are the participating countries of Malé Declaration?
……

2. Name the National Focal Point for Malé Declaration in Maldives?
……

3. Name the three main pollutants the Male' Declaration wishes to measure?
……

4. Why are the Malé Declaration monitoring site located in remote areas?
……

5. What effects do air pollutants have on human health?
……
……

6. Air pollution can potentially result in fish kills in lakes.
True or False

7. Air pollution can have both good & bad effects on plants.
True or False

8. Air pollution can cause the corrosion of statues and man made materials such as paints.
True or False

9. Indicate if true or false:

a)	Concentration of air pollutants is measured in ppm by volume.	True	False
b)	5 mg/L is the same as $5g/m^3$.	True	False
c)	High volume sampler is used to measure dry deposition rate.	True	False
d)	Wet only collector is used to measure rainfall.	True	False
e)	EC meter can be used to indicate dissolved solids concentration.	True	False
f)	Impingers are here used to collect SPM in air.	True	False
g)	Unfiltered air is bubbled through Envirotechs impingers.	True	False
h)	Water in the manometer in high volume sampler should be replaced every 6 months.	True	False

10. Indicate the most appropriate or correct answer:

(a) With increase in altitude
(i) pressure decreases (ii) temperature remains constant (iii) density of air increases (iv) wind speed decreases

(b) which of the following is a secondary pollutant
(i) NO (ii) SO_2 (iii) O_3 (iv) Pb

(c) Wind rose diagram is a representation of
(i) Wind temperature (ii) Wind direction and speed
(ii) Wind humidity (iv) Wind pressure

(d) Which of the following instruments measures hydrogen ion concentration
(i) EC meter (ii) Spectrophotometer (iii) Bulk collector (iv) pH meter

(e) The cyclone in Hi-vol sampler

(i) collects respirable dust (ii) protects filter paper from moisture (iii) collects particles less than 10 μm size (iv) collects particles greater than 10 μm size

(f) If 1 mL of a 10 mg/L standard NO_2 solution is added to 9 mL of reagents the concentration will be

(i) 10 μg/L (ii) 1 μg/10 mL (iii) 1 g/m3 (iv) 1 ng/mL

(g) If 10 g S is burnt SO_2 production will be

(i) 10 g (ii) 20 g (iii) 32 g (iv) 64 g

(h) For gaseous sampling using impinger? the air flow rate is usually kept at

(i) 1-3 m^3/h (ii) 1-4 m^3/min (iii) 1-5L/min (iv) 1-4 mL/min

11. Calculate the dust concentration in air in μg/m^3 if 2 g dust is suspended in 1000 m^3 of air.

……..
…….

12. What is the total amount of air in m^3 which is filtered if a Hi-Vol sampler sucks air at an average rate of 0.5 m^3/min for 8 h.

…….

……
…….

13. What will be the volume of 273 m^3 of air which is at 0°C, if heated to 27°C.

……..

……
……..

14. What is wet deposition

……..
…….

15. What is dry deposition

……..
…….

16. How can you estimate dry deposition

……
……...

17. What is the approximate average time a sulfur compound (as SO_2 or sulphate particle) spends in the atmosphere

a) 6hrs b) 1 day c) 4 days d)10 days e) 1 month f) 6 month g) 1 year

18. Can transboundary transport in the atmosphere be a problem for Sri Lanka? ……
Why? ……..

19. Deposition of pollutants from the atmosphere can be a problem. Give some examples?
……..
……..

20. Can diffusive (passive) sampler be used for measuring the SO_2 concentration in air?
…….

21. Do you need a pump for diffusive (passive) sampling?
…….

22. Can you analyse the diffusive (passive) samplers yourself ?
…….

23. How should the diffusive (passive) sampler be mounted?
……..

24. What should you do with the sample if you find bird dropping in the funnel of bulk collector?
…….

25. Why do you need gloves when handling the bulk sampling equipment?
…….

26. Why should you shake the sample a little before taking out a fraction of it from a bulk sampling equipment?
…….

27. When do you take out samples from the wet only collector?
…….

28. Suppose that it is raining a lot and the bottle is more than 80% full already after 3 days. What do you do?
……
……...
……...
…….

29. Suppose that after installation of a collection bottle it become fill already the same afternoon. What do you do?
……..….
……..…….

30. What do you do
(a) If the lid becomes damaged?
(b) If the wet only collector does not work properly or not at all and there is no obvious error?

31. Are you aware of the health and safety issues associated with analyzing the samples in the laboratory? Yes and no. Give example.
……...…
……..……

Learning rainwater sampling

Learning Air sampling

Some Photographs from the Training Programme

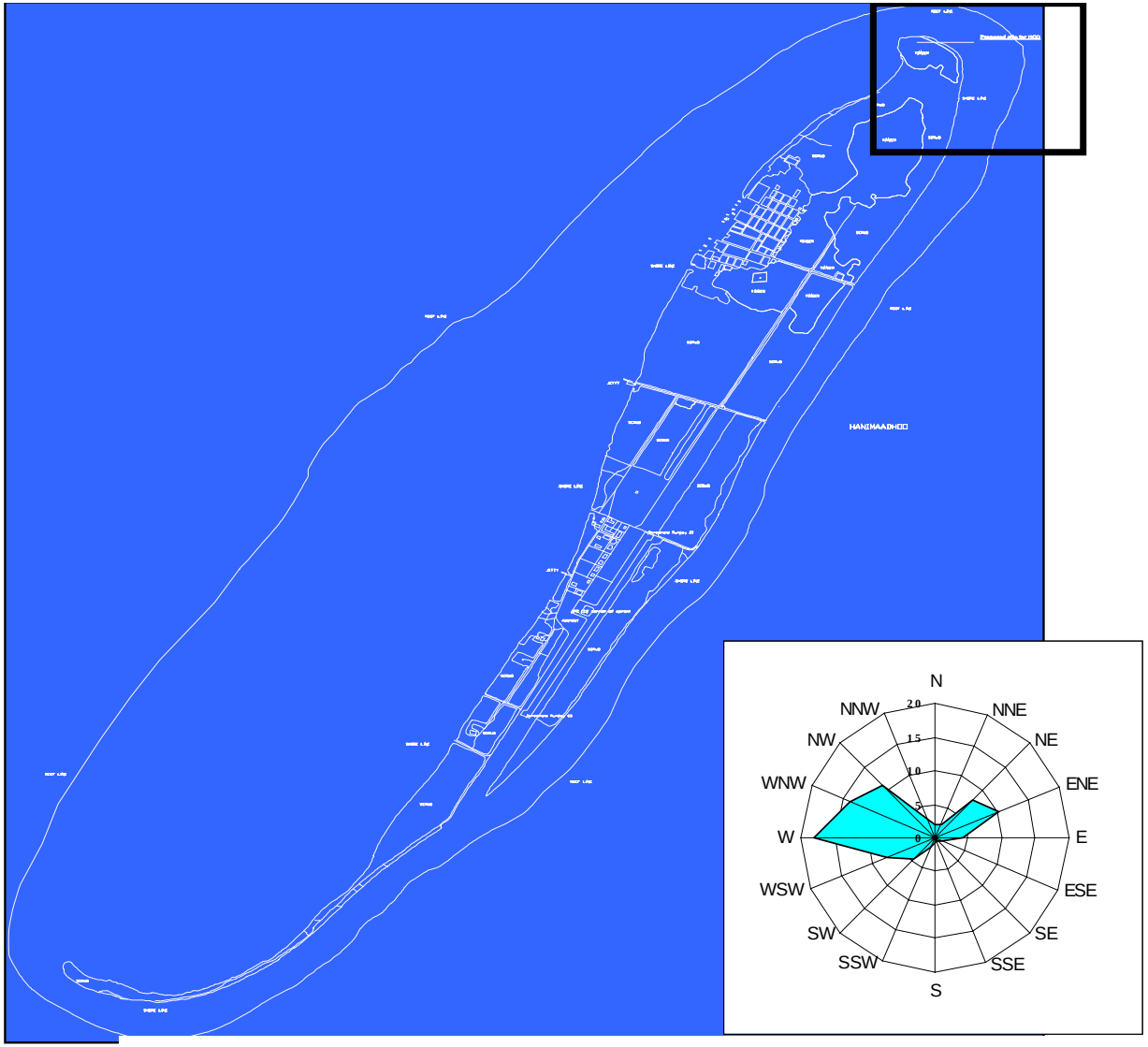

Figure 1: Map of Hanimaadhoo Island with Monitoring site